NORTH POLAR PROBLEMS.[1]

THE deep North Polar Basin forms the northern termination of a series of depressions of the earth's crust extending north through the Norwegian Sea from the eastern side of the Atlantic, and dividing between the continental masses of the old and the new world. The eruption of the Jurassic basalts of Franz Josef Land and Spitsbergen may have had some connection with the sinking in of the North Polar Sea bottom, but the basin was probably to a great extent formed before that time. Newer volcanic rocks are not known hitherto from the edges of the North Polar Basin. On Bennett Island, De Long reports lava (or basalt), but we do not know its age.

It is most improbable that any block of land (horst) should have remained isolated in the middle of such a basin, surrounded by deep water on all sides, and without having any connection with the surrounding lands or continental shelves. It is, therefore, of essential importance to determine the edge of the continental shelf off the known coasts. But the edge of the North Polar continental shelf is only known exactly in two places—north-west of the New Siberian Islands and north of Spitsbergen—whilst in the region between these two places we know the deep sea to the north. In the remaining part of the North Polar Sea we know as yet very little about the edge of the continental shelf.

The rule that the continental shelves are generally much narrower outside high and mountainous coast than off flat and low lands holds good only where the mountain formations of the coast are in near relation to the trend of the coast and to the continental slope outside, and also where the mountainous coast is built up by primary rocks. This seems hardly to be the case on the northern coast of the American Arctic Archipelago and Greenland, although there are rather high promontories in some places. It is, therefore, difficult to say much about the extent of the continental shelf there. It is perhaps more the case along the north coast of Alaska, and therefore the continental shelf may possibly be narrower in that region; but even this is uncertain. The deeper soundings taken near the supposed edge of the shelf may simply indicate depths of submarine valleys, which may be numerous in this region, and many more and deeper soundings are required before we can say anything with certainty.

Dr. J. W. Spencer's conclusions as to the width of the continental shelf (*American Journal of Science*, vol. xix., No. 113, May, 1905), drawn from the great depths of the submarine fjords of the American Arctic Archipelago, are hardly well founded. Considerable depths of the submarine valleys and channels (fjords) do not point to a comparatively narrow shelf in regions where there has been glacial erosion. It ought also to be considered that, on the whole, the region of the American Arctic Archipelago exhibits geomorphological features which are exceptional. This region was probably near the heart of the great North American Ice age, and the land has been split up into islands and peninsulas, whatever the original cause of this dissection might have been.

It cannot, therefore, be said that the geomorphologic features of the known part of the Arctic regions exclude the possibility of a wide extension of the continental shelf, possibly with lands on it, into some parts of the Unknown North.

The Sea Currents and *the Drift of the Ice* seem to indicate that there is an extensive area of sea to the north of the *Fram's* track. Peary's experiences during his latest expedition also indicate that there is much sea to the north of Greenland. The ice-drift converges towards the opening between Greenland and Spitsbergen. Peary's observations of a rapid eastward ice-drift also indicate that there cannot have been much land to the east of his northward track; but as we do not know the depths over which Peary travelled, we cannot say much with regard to the possibility of land or continental shelf further north and east.

The drift of the *Jeanette* can hardly be said to indicate land to the north, as this drift was chiefly influenced by the winds.

My conclusions with regard to an actual current in the surface-layers of the North Polar Basin, pointing towards Franz Josef Land and Spitsbergen ("The Scientific *Fram* Report," vol. iii.), might seem to indicate that there was land to the north, and that the North Polar Basin is a long and narrow depression. For, owing to the earth's rotation, we might expect a surface-current of this kind to be deflected towards the coast on its right-hand side, *i.e.* towards the Greenland and American side. It is, however, probable that the winds and ice-drift in the unknown parts of the sea might have influenced the direction of our drift, and that therefore the results arrived at as to the direction of the current are not quite correct.

R. A. Harris's contention that the difference in the magnitude of the *tides* on Bennett Island and the coast of Alaska proves the existence of extensive land to the north is based on a much too scanty material of observations. On the northern coasts of Franz Josef Land I found a smaller tide than the *Jeanette* people on Bennett Island.

The possible differences shown by the *ice* in the Beaufort Sea, on the coast of Prince Patrick Island, north of Ellesmere Land and Greenland, and in the sea crossed by the *Fram*, cannot be said to point to the existence of land in the Unknown North.

The occurrence of *driftwood* on the northern coasts, and even on the floe-ice itself (north-west of Greenland), proves that this ice must have drifted across the unknown sea from Siberia or America. The great quantity of "*post-Glacial*" *driftwood*, found even at high elevations on the now ice-bound coasts in the north, points to a milder period in post-Glacial times with a more open North Polar Sea.

Methods of Exploration.—The drawback with sledge journeys across the Polar ice is that they do not give much opportunity of soundings and oceanographical work; but something could be done by a practical equipment. Determination of the edge of the continental shelf would be most important, but also some observations of the temperature and salinity of the deep-water strata of the deep sea beyond this edge would be of value.

A drift with a ship across the Unknown North from the sea north of Behring Straits or Western Alaska, and towards Greenland, would give important results, and could be done probably in five years, although the drift-cask of Bryant and Melville took nearly six years from Alaska to Iceland (from September 13, 1899, to June 7, 1905).

[1] Abridged from a paper by H.E. Dr. Fridtjof Nansen, G.C.V.O., read before the Royal Geographical Society on April 29.

SEISMOTECTONIC LINES.[1]

IN studying the distribution of the towns and villages damaged by Calabrian earthquakes, Prof. Hobbs finds that they show a noteworthy tendency to grouping along series of essentially parallel straight lines (seismotectonic lines), which he believes are related to coast-lines, borders of mountain-masses, boundaries of geological formations, &c. The places most seriously damaged are generally situated at or near the intersections of indicated seismotectonic lines, while these lines often intersect lines of volcanoes (volcanotectonic lines) at volcanic vents. In the direction perpendicular to seismotectonic lines, he states that the destructive intensity of the waves falls off rapidly, having but little effect upon well-built houses more than a mile distant, except in the case of earthquakes of the first order of intensity. He therefore concludes that "the destructive violence of an earthquake is localised on vertical planes of fracture within the earth's crust; along which cracks the seismic waves are transmitted with the least loss of intensity."

The district chiefly affected by the Calabrian earthquakes is one in which the peculiar earth-sounds, known as brontidi, mistpoeffers, &c., frequently occur. Recent investigations by Cancani, Alippi, and others have shown

[1] (1) "On some Principles of Seismic Geology"; (2) "The Geotectonic and Geodynamic Aspects of Calabria and North-Eastern Sicily, a Study in Orientation." By William Herbert Hobbs. (*Beiträge zur Geophysik*, Bd. viii., pp. 219–362, and plates.)

that these sounds are closely connected with ordinary earthquake-sounds, and Prof. Hobbs finds that the Calabrian villages from which brontidi are reported are also those which have suffered most from disastrous earthquakes, and that they are ranged along the more prominent seismotectonic lines of the district.

In great detail Prof. Hobbs studies, not only the places damaged by the important earthquakes of 1638, 1659, 1783, 1894, and 1905, but also those at which numerous slight shocks were observed, for the latter, owing to their small disturbed areas, seem to be the most useful indices of the course of seismotectonic lines. The positions of more than 300 such lines in Calabria and north-eastern Sicily are estimated and drawn upon a series of maps, as well as the bearings of joint-planes, the trend of the volcanotectonic lines, and the distribution of brontidi.

It will be seen from this brief abstract that Prof. Hobbs's memoirs possess considerable interest. They are the result of extensive reading, and contain many useful references. But his wide generalisations seem to me to be based on insecure principles and insufficient data. Isoseismal lines, it is well known, are elongated in the direction of the originating faults, but the positions of a few places at which shocks are felt cannot determine a line of fracture. For instance, one of the British seismotectonic lines is located by the positions of four places, two of which are more than 200 miles apart. The seismotectonic lines revealed by the New England earthquake of 1870 are based on the positions of about a score of places distributed over an area reaching from Quebec to Newhaven, and on about a dozen apparent directions of the shock. When observed in houses, such directions are almost invariably perpendicular to the principal walls, but Prof. Hobbs assumes that they indicate that the shocks were transmitted along parallel seismotectonic lines. In Calabria, on the other hand, the damaged villages are so numerous that it would be strange if many of them were not collinear. Several of the seismotectonic lines plotted by Prof. Hobbs no doubt correspond with lines of fracture, but the existence of a very large number of his lines must, I think, be regarded as doubtful. Industrious as he has been in the collection of materials, he has tried within little more than a year to achieve results which the long-continued labours of many men might fail to establish.

C. DAVISON.

HYDRATES IN AQUEOUS SOLUTION.

A RECORD of researches which have been carried out by Prof. H. C. Jones with his students and confrères has recently been published by the Carnegie Institution.[1] The investigations which have been undertaken were to elucidate an observation made by Jones and Ota when studying the freezing points of solutions of double salts in order to ascertain whether in solution they remained as constituent molecules or were broken down. They found that concentrated solutions gave abnormally low freezing points, the molecular lowering of freezing point passing through a well-defined minimum as the concentration changed. Now according to the ionic theory as then expressed, the molecular lowering should decrease continuously as the concentration of the solution increased.

A very large number of solutions of salts, acids, and bases, and neutral organic substances have now been studied, and as a result it has been found that this excessive depression as the concentration increases is a general property of solutions. In order to explain this digression from the generally accepted rendering of the ionic theory, Jones postulates that "in solution a part of the solvent is combined with the dissolved substance and no longer plays the *rôle* of solvent, at least so far as the freezing point method is concerned."

By a determination of the freezing point, conductivity, and specific gravity of the solutions, it has been found possible to calculate approximately the total amount of water held in combination by the dissolved substance, and consequently the approximate amount combined with one molecule of the compound or of the ions resulting from it.

[1] "Hydrates in Aqueous Solution." By Harry C. Jones. Pp. viii+264. (Washington: Carnegie Institution, 1907.)

The theory proposed here differs from that suggested by Mendeléeff, who considered that such substances as sulphuric acid and calcium chloride form a few definite compounds with the water in which they are dissolved. But the present theory supposes that combination between the dissolved substance and water to be a general phenomenon. The compound forms, say, for example, calcium chloride, a complete series of hydrates extending from a few molecules of water to at least thirty, all the intermediate stages being represented.

The memoir commences with an introduction, in which the earlier work is reviewed and the freezing-point and conductivity apparatus used by the author are described. Then follows part i., dealing with the evidence for the existence of hydrates in aqueous solution and the approximate composition of the hydrates formed by a large number of electrolytes. The work here described was carried out by Getman and Bassett. Attention is directed to the effect of temperature on water of crystallisation, as bearing on the theory of hydrates in solution. It is shown that salts which on crystallisation contain water of crystallisation are able to combine when in solution at ordinary temperatures with a much larger quantity of water than they are able to bring with them out of solution on crystallisation. The results obtained are illustrated in many cases graphically by curves and in other cases by tables.

Part ii. is chiefly the work of Uhler, and deals with spectroscopic investigations. The spectrographic photographs which are given have been magnificently reproduced, and form quite a feature of the book. The colour changes produced, for example, by the addition of different salts to cobalt salts have been investigated quantitatively. That is to say, the absorption spectra of the substances, separately and when mixed in known quantities, have been observed with a direct-reading spectroscope, and thus the wave-lengths and absorption bands obtained. The special spectrograph which has been used to obtain the photographic record of the absorption bands is also described. The final section deals with non-aqueous solutions, the solution of substances in methyl and ethyl alcohol having been studied. The results seem to indicate that some substances at least, such as lithium chloride, bromide, and nitrate, combine to some extent with the solvent. However, this portion of the work is yet in its initial stage, and much yet remains to be done. We understand that the author is extending the work in this direction.

Altogether, the memoir is an extremely valuable contribution to the study of the subject, more especially in connection with concentrated solutions. It has often been urged, and with a considerable amount of truth, that the ionic theory is simply a specialised hypothesis, which is true only of dilute solutions. Prof. Jones has gone far to remove this reproach by broadening the basis of the theory and enlarging its scope. The publishers, the Carnegie Institution, must also be congratulated upon the splendid way in which the letterpress and diagrams have been got up.

F. M. P.

PRODUCTION AND DECAY OF MEDIÆVAL STAINED GLASS.[1]

THE earliest direct evidence as to the methods of mediæval glass-painting is contained in the treatise of Theophilus ("Diversarum Artium Schedula"), which dates back in all probability to the latter half of the twelfth century; here one finds detailed instructions for the making of the glass as well as for its formation into the flat sheets or "tables" in which it is required by the glass-painter.

This treatise makes it clear that at that time such window glass was for the most part made by what is generally known as the "muff" process. The process referred to is one of the three known methods of making window glass, namely:—

(1) Cast or plate glass, made by pouring molten glass on to a flat stone or metal slab.

(2) Muff or cylinder glass, in which the glass is worked

[1] Abstract of a paper read before the Society of Arts on March 13 by Mr. Noel Heaton.